

## APPLICATION OF REUSABLE SOFTWARE COMPONENTS AT THE SEI

Robert Holibaugh  
Software Engineering Institute

Robert Holibaugh of the Software Engineering Institute described a project which is studying the application of reusable software components. The primary goals are to gain practical experience with state-of-the-art reusable components, methods, and tools and to capture the lessons learned in the application of reuse technology. In addition the project will assess the impact of reuse on the software development process and products and will identify and validate the information that facilitates software reuse during system development. The project includes two tasks - a reuse experiment and a redevelopment effort. The reuse experiment will define a life cycle and a methodology for reuse-based development, and define and implement a data collection mechanism for measuring the development. The redevelopment effort will construct a reuse test bed and will redevelop and realistically test subsystems from an embedded mission-critical real-time application. The reuse experiment will produce several products including a tested real-time application, reuse-based components and tools evaluation, a reuse-based development method, a framework for data collection, a framework for measuring productivity, and lessons learned data. Successful development with reusable components will require a rich set of components and an integrating methodology. The Tomahawk Land Attack Missile system is the application for the redevelopment effort. A number of goals and questions relating to the reuse experiment were presented. The project environment included several types of workstations, target hardware, and a number of software support tools. Several reports from the project are already available.

# **Agenda**

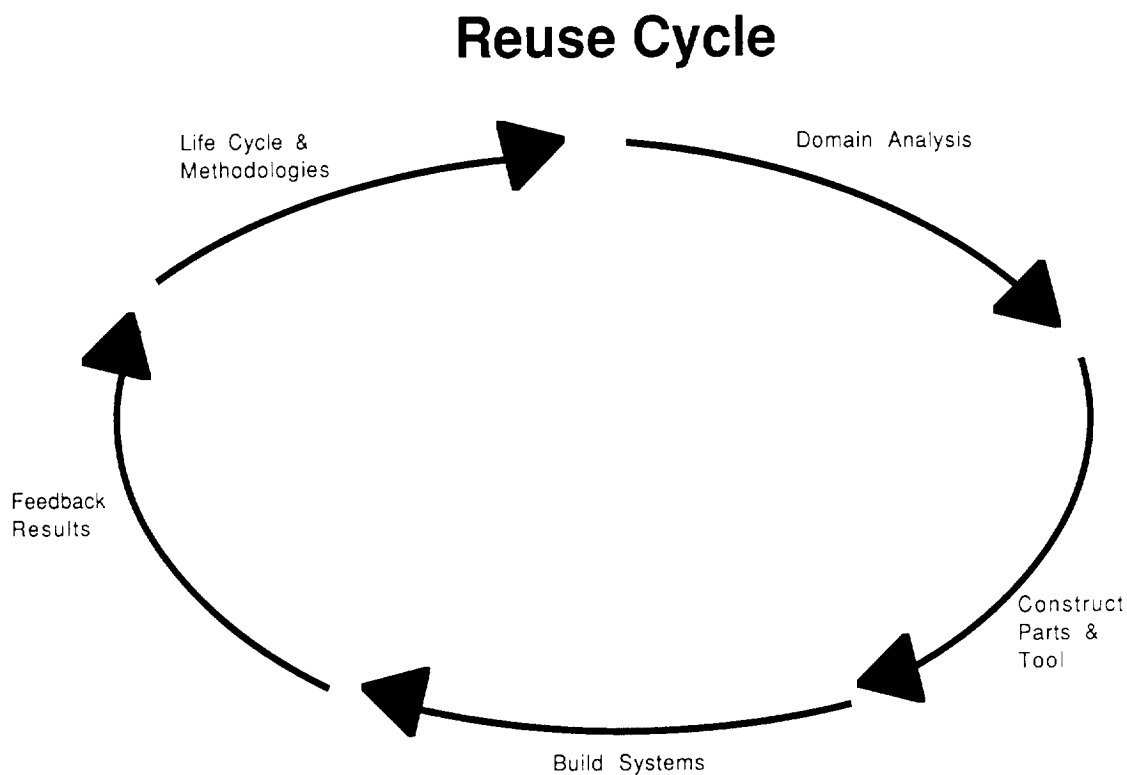
- **Project Goals**
- **Reuse Experiment**
- **Project Environment**
- **Project Status**

## **Goals**

- **Gain practical experience with state-of-the-art reusable components, methods, and tools; and capture lessons learned in the application of reuse technology**
- **Assess the impact of reuse on software development process and products (in particular, on design)**
- **Identify and validate the information that facilitates software reuse during system development**

# Project Tasks

- **Reuse Experiment**
  - **define life cycle and a methodology for reuse-based development**
  - **define and implement data collection mechanism for measuring the development**
- **Redevelopment Effort**
  - **construct reuse test bed**
  - **redevelop and realistically test subsystems from an embedded MCCR application**



# **Reuse Experiment Motivation**

- **Motivation:** Integrate and improve the application of reuse
- **Purpose:** Investigate impact of systematic reuse on 'real' development
- **Value:** Establish empirically supported guidelines for reuse

# **Reuse Experiment Products**

- Tested real-time application
- Reuse-based components and tools evaluation
- Reuse-based development method
- Framework for data collection
- Framework for measuring productivity
- Lessons learned/development data

# **Reuse Position**

**Given sufficiently rich and powerful set of reusable components, methods, and tools for an application domain, and a (integrating) methodology for systematically applying reuse**

***THEN* successful development will:**

- **require significant effort for reuse related tasks**
- **encounter new problems**
- **benefit from reuse over multiple projects**

## **Subsystem Redevelopment**

- **Application - Tomahawk Land Attack Missile (TLAM)**
  - **Acquired domain-specific reusable components**
    - **CAMP**
  - **Acquired domain expertise - Raytheon**
  - **Acquired interested DOD program office - Cruise Missile Program Office**
- **Acquired the original requirements, functional specification, and design**

## **Subsystem Redevelopment (con)**

- **Develop and test the subsystems under constraints "similar" to MCCR contractors (e.g. 2167A and ISP)**
- **"Monitor" the development of the subsystem (Basili86)**

## **Experiment Goals**

- **Describe the impact of software reuse on process and products (specifically design)**
- **Describe the use of reuse-based resources: components, methods, tools**
- **Identify information (through applications, documentation, reports, etc.) that will facilitate reuse**
- **Capture and disseminate lessons learned**

## Questions

- Reuse extent & frequency(Q1)
- Training, experience, & support(Q2)
- Relative contribution of reuse(Q3)
- Related reqs & design decisions(Q4)
- Properties of the System(Q5)
- Impact on quality(Q6)
- Integral concept(Q7)
- Effectiveness of CAMP(Q8)
- U.Md/NASA standard data(Q9)

## Metrics

- Document the capabilities of development staff
- Instrument the development process
- Evaluate the development products
- Evaluate the reusable components, methods, and tools

# Project Environment

- **Hardware:**
  - **VAX Cluster** provides a workstation for each developer
  - **Symbolics 3670** supports **AMPEE**
  - **IBM PC-AT** supports **Asset Library System**
  - **Motorola 68020 Target Hardware**
- **Software:**
  - **VAX Ada Tool Set** (editors, compiler, debugger, configuration manager, etc.)
- **Statemate**
- **ADADL** (Ada PDL tool set)
- **Interpretative Simulation Program (ISP)** from **NWC**



# **ARSC Reusable Software**

- **Component libraries**
  - **Common Ada Missile Packages**
  - **Booch Abstract Data Types**
  - **EVB Abstract Data Types**
  - **Ada Software Repository**
- **Ada Missile Parts Engineering Expert (AMPEE)**
- **GTE Asset Library System**

## **GTE Asset Library System**

- **Uses 'faceted' approach to Reusable Software classification**
  - **Missile operational parts**
  - **Kalman filter and math parts**
  - **General purpose parts**
- **Runs on IBM PC AT**
- **GTE has assisted in facet identification and parts classification**

# Testing Considerations

- **Required to verify/validate performance of software**
- **Required to verify accuracy of experiment results**
- **Realistic to project scope**
- **Credible to external reviewers**

## Testing Options

- **Code Inspections**
- **Unit testing on VAX**
- **Simulation on VAX**
- **Simulation on VAX with target machine(Motorola 68020) in loop**
- **Simulation with hardware in loop**
- **Flight test**

# **Transition**

- **Work with GTE on evaluation of ALS and report findings**
- **Work with Raytheon/??? on evaluating the system attributes**
- **Report on software experimentation and data collection mechanisms**
- **Report on reuse-based methodology**
- **Report on lessons learned from the experiment**

## **Project Reports**

- **Phase I Test bed Description: Requirements and Selection Guidelines  
(CMU/SEI-TR-88-013)**
- **Subsystem Redevelopment: Analysis  
(CMU/SEI/TR-88-014)**
- **Perspective on Software Reuse  
(CMU/SEI-TR-88-022)**
- **Experiment Design Report: High Level Design  
(CMU/SEI-TR-88-32)**
- **Experiment Planning for Software Development  
(Dec 1988)**

- **Software Methodology in the Harsh Light of Economics**  
(Dec 1988)
- **Experiment Design Report: Detailed Design**  
(Dec 1988)
- **Reusable Software Component Construction**  
(SEI Affiliates Symposium, Jun 1989)

## **Planned Project Outputs**

- **Project Reports**
  - **Reuse Life Cycle and Methodology Report**  
(Feb 1989)
  - **Classification of Reusable Components**  
(Apr 1989)
  - **Final Project Report**  
(Dec 1989)
- **Project Presentations**
  - **Reuse, Where to Begin and Why**  
(Feb 1989)

- **Classification of Reusable Components  
(Mar 89)**
- **CAMP Training  
(Apr 1989)**
- **Reusable Requirements  
(May 1989)**
- **CAMP Users Workshop  
(Jun 1989)**

## **Completed Tasks**

- **Jul 87 - Testbed definition**
- **Sep 87 - Domain selection**
- **Nov 87 - Raytheon affiliate**
- **Dec 87 - Installation of Vax Cluster & Symbolics**
- **Jan 88 - Experiment review**
- **Apr 88 - Software Development Plan**
- **Aug 88 - Requirements analysis**
- **Oct 88 - Software Specification Review**

